

K2 Field 0 proposal

Tracing the evolution of convection, pulsation and rotation in gamma Doradus stars in clusters

Timothy Van Reeth (PI, PhD student) and Andrew Tkachenko (promotor),
University of Leuven (Belgium) and members of KASC WG 3

Our goal is to detect and do an asteroseismological study of gamma Doradus stars in clusters with the K2 mission.

Gamma Doradus stars are late A-/early F-type main-sequence stars which show gravity-mode oscillations with periods on the order of a few hours to a few days. Because of the low amplitude of their variability, the results from ground-based observations were limited, and before the launch of the space missions, the oscillations were thought to be sinusoidal (Henry *et al.* 2007, AJ 133, 1421). Thanks to the MOST, CoRoT and *Kepler* missions however, it became clear that this is not the case, and the variability of gamma Doradus stars often shows strong similarities to the non-sinusoidal modulations encountered in light curves of pulsating white dwarfs. For these pulsators two phenomena were shown to contribute: (a) the nonlinear dependence of the emitted flux on the local temperature of the stellar surface (Brassard *et al.* 1995, AJSS 96, 545), and (b) nonlinear coupling between oscillations, caused by the convective envelope (Wu *et al.* 2001, MNRAS 323, 248; Yeates *et al.* 2005, AJ 635, 1239). In gamma Doradus stars these interactions happen on different timescales and are influenced by the higher rotation rates. The theory developed for oscillations in white dwarfs can therefore not be applied to gamma Doradus stars. However, it does make these pulsators an ideal testing ground to improve the characterisation and modelling of the interaction of pulsations, rotation and convection.

The targets we requested, are candidate gamma Doradus stars located in the clusters in field 0. Similar targets will also be requested for the clusters located in the following fields of view of the K2 mission. Compared to field stars (such as the stars observed during the initial *Kepler* mission), cluster stars provide us with additional information on their ages and metallicities. This allows us to model the evolution of the gamma Doradus pulsators and their convective envelopes throughout their lifetime. For all targets long-cadence observations are more than sufficient, as the variability is usually far below the corresponding Nyquist frequency. For targets brighter than 11 mag ground-based spectroscopic follow-up observations are guaranteed with the HERMES spectrograph at the Mercator telescope. We will use the obtained data to determine the stars' membership of their respective clusters and do a sample study of their variability, before analysing the individual targets to look for nonsinusoidal light curve modulations. In this project, we are relying on the experience we gained by conducting a similar study on a sample of gamma Doradus field stars in the original *Kepler* field of view, which was composed by the Leuven team (Tkachenko *et al.* 2013, A&A 556, A52).